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Research on the Application of Internet of Things in Airport Enclosure Intrusion Detection and Alarm System

Yao Xiao Feng[1], Chen Xiao Long[1]，Xu Hui Pu[2]
School of Electrical and Information Engineering, DaLian JiaoTong University, DaLian city, China
Automation Research Center, DaLian Maritime University, DaLian city, China
Email: yxf811@163.com，177097626@qq.com，hpx1212@163.com

(Abstract) An airport enclosure intrusion detection and alarm System based on internet of things was presented in this paper, the paper focus on ZigBee wireless communication protocol network, gave out the hardware and software design method of intelligent wireless sensor node through applying CEL ZigBee development kit. Obliquity, tension, video and other data acquisition was completed to provide data basis for the invasion judge and the final decision-making. At the same time, wireless communication protocol data format was defined, and the wireless communication was realized on the bases of inherent protocol stack of the development kit. On the other hand, an embedded ZigBee wireless gateway was developed based on embedded systems, ZigBee technology and Ethernet technology, which is the pivotal device to realize the network interconnection between ZigBee and internet by means of completing the protocol conversion. The system would play more important role in intelligent transportation, public safety, intelligent fire-fighting, industrial monitoring and other fields.

Keywords: Internet of Things, Airport enclosure, Intrusion detection and alarm system, ZigBee network

1. INTRODUCTION

Intrusion detection alarm system usually includes five components: airport enclosures alarm subsystem, linkage control subsystem, video monitoring subsystem, communication network, security management platform [1]. In order to effectively prevent persons crossing, terrorist attacks, etc., the airport generally adopts the means such as setting up some barriers or obstructions, arranging patrols to achieve the detection of invasion effects. The traditional means are often influenced by time, geographical situation and the other factors, which is difficult to adapt the security needs. Therefore, the installation of digital intrusion detection alarm system has become an inevitable requirement. The digital control system is usually laid tens of thousands of sensor nodes to cover the ground, fences and low-altitude areas, sensor node adopt front-end detection technology such as infrared detection, the laser beam, sensor cable and video to collect obliquity, tension, video and other data to provide data basis for the invasion judge and the final decision-making. So it has become particularly important that how to connect mass sensor nodes into a network and achieve the full data integration.

Internet of things is a technology extended and expanded from internet, and the exchange of information and the data communication have made its client reach to any things. As a physical world network with the characteristics of comprehensive sense, reliable transmission and intelligent processing, Its application was carried out mainly through the sensor nodes, the network (including wireless networks, cable networks) and information processing platform [2,3,4]. It provides a broad development space for wider range of data sharing through that internet of things technology was applied into airport enclosure intrusion detection and alarm system[5,6]. In this paper, mass sensor nodes were connected to a ZigBee wireless sensor networks under the framework of internet of things, the gateway was designed to complete the protocol conversion of hybrid network, so remote monitoring of intrusion effects can be realized through the network interconnection between ZigBee and internet.

2.CONSTITUTION OF SYSTEM BASED ON INTERNET OF THINGS

The whole system is divided into three layers. Sensor layer was composed of intelligent nodes based on the ZigBee network, RFID readers, sensors, video devices and other components. The mainly task of the underlying sensor

system is that completed the signal acquisition to provide data basis for the invasion judge and the final decision-making. Network layer is mainly complete fast, reliable and secure data transmission through a variety of wired/wireless communication network, sensor information and control commands were transmitted between sensor layer and application layer. Communication networks of network layer including 2G, 3G, Wi-Fi and internet, etc. information can be transmitted by any kind of network or combination of several networks. Network layer can also be divided into management center of internet of things and information center of internet of things, the management center is responsible for the identification, management, certification, authentication and billing of goods code. Information center is responsible for information storage and unified analysis and computing. Application layer is the core of the system, the application layer can achieve a variety of reality application of internet of things under the support of layer and network layer, it mainly responsible for collect and share massive information and make decision based on analyze results. The constitution of system based on internet of things is shown in Fig.1:

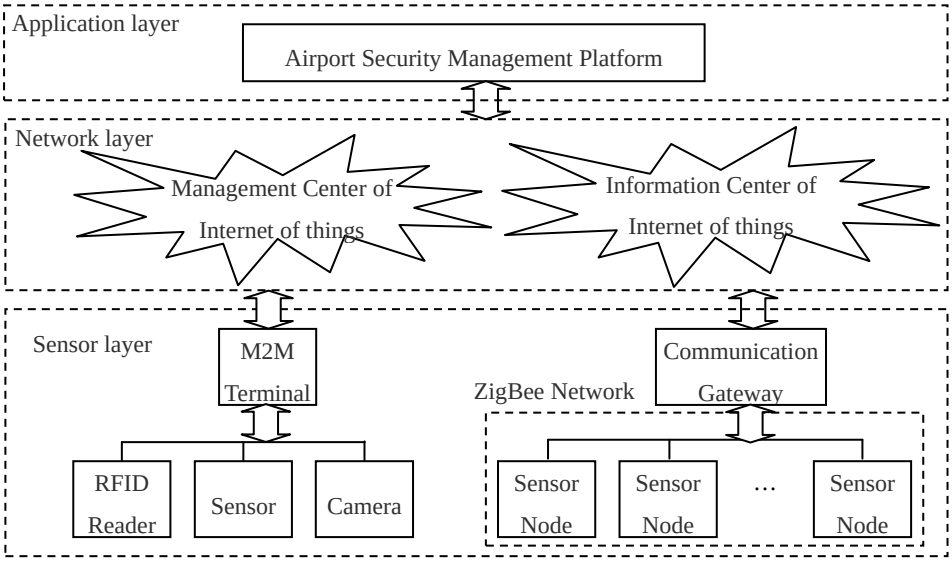

Fig.1 Airport Enclosures Intrusion Detection and Alarm System based on Internet of Things

2.1 ZigBee network

As one of the most new wireless network protocol, ZigBee adopts direct sequence spread spectrum (DSSS) technology, the working frequency is 868MHz or 2.4GHz (ISM license-free band). Its data transfer rate is only 20-250kb/s (2.4GHz) or 20kb/s (868MHz), which meet the needs of low-speed data transmission applications. Its power consumption is relatively low as the duty cycle is short and the adoption of sleep mode, 2 AA batteries can maintain 6-24 months, which eliminate the need for charging or frequent replacement of battery. At the same time, communication delay and sleep activation delay are very short under the circumstance of delay time is optimized, typical communication delay is 30ms, and typical sleep activation delay is 15ms. Low baud rate, free patent and simple protocol greatly reduced development costs, and network node hardware cost of ZigBee is generally under ¥100. ZigBee provides three kinds security modes, illegal data access can be prevented through using access control lists, and collision avoidance mechanism ensured high data transmission reliability. The middle layer adopts the full acknowledge access control transportation mechanism, each packet must wait for acknowledgement from the receiver. Network capacity: A ZigBee network can accommodate up to 65536 slave device and a master device, up to 100 ZigBee network can exist within an area [7,9]. Which happens to meet the requests of the intrusion alarm systems, coupled with ZigBee networks can be seamlessly integrated with the Existing control network standards, so it is very easy that remote monitoring of alarm system can be implemented:

2.2 Design of sensor node

As a high performance ZigBee module of CEL company, ZIC2410 is a true single-chip solution, which complies with the ZigBee specification and the IEEE 802.15.4 standard, it consists of a RF transceiver with base-band modem, a hard-wired MAC and microcontroller equipped with 8051core (with internal Flash memory), The module selected the most commonly used on-chip peripherals, that

is multiple GPIO pins, timers, UART, SPI, etc., the highly integrated module greatly simplified the design, cut down power consumption, and save the cost of the entire system, the necessary external devices of ZigBee module, high frequency traces and the other complex process were

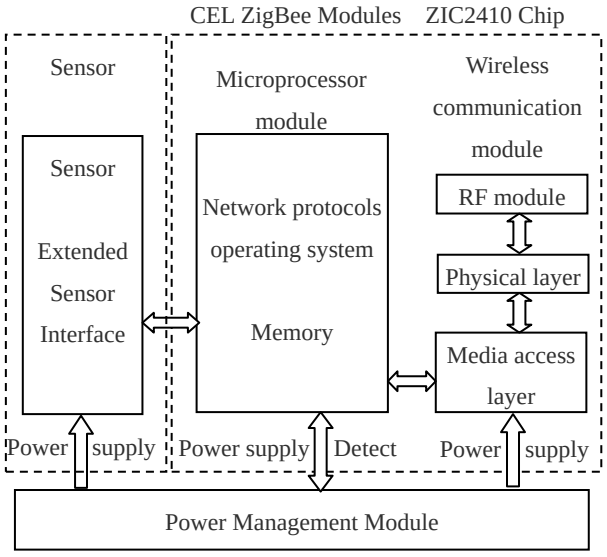

Figure 2, sensor node hardware block diagram

hided, and the users with no RF knowledge can use the chip directly in accordance with ordinary chip, this greatly reduce the hardware design difficulty of ZigBee networks. The ZigBee module was selected to complete the design of intelligent nodes in this system. Sensor node consists of four modules[8]: sensor modules was used to realize data acquisition, the microprocessor module was used to implement communication protocols and data processing, wireless communication module is responsible for complete ZigBee network access, power management module is responsible for power for sensor nodes[8,9]. The nodes block diagram is shown in Fig.2:

3. REALIZATION OF NETWORK INTERCONECTION BETWEEN ZIGBEE AND INTERNET

3.1. Solution of network interconnection

So-called the "last mile" of internet of things_ WSN (wireless sensor network) can transmit the acquired information to the internet in real time for treatment. However, the size of a cluster in WSN can not be too great due to transmission distance of WSN node is too short, nevertheless, Ethernet, as the most widely installed local area network., which can complete the function that the WSN can not do, Ethernet transmit data packets at the speed of 10-100Mbps between devices, it support full-duplex data transmission and has the best opening performance. So it became the most important focus that how WSN connect to Ethernet, in this paper, an embedded ZigBee wireless gateway based on ARM chip was designed to realize the network interconnection between ZigBee and internet, which includes the selection of main function modules and the design of interface circuit, device driver modules and user application software were also be developed to complete protocol conversion between ZigBee network and internet and ensure data can be transmitted reliably.

3.2. Design of wireless gateway

The gateway was designed through the secondary development on the basis of EASYARM8962 development board, development board consists of the following

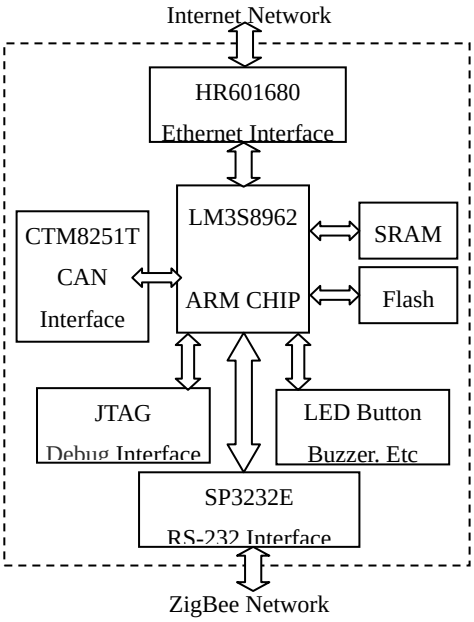

Fig.3 Gateway hardware block diagram

components: TVS power protection circuit, JTAG debug interface, reserved large capacity FLASH, LM75 temperature sensor, RS232 interface, backup battery of sleep module, AD interface, isolated CAN interface, DA infrared interface, Ethernet interface. special chip integrates a large number of on-chip devices for the development, such as TCP/IP protocol stacks, Ethernet controllers, etc., which greatly reduced software development cycle and development difficulties, The existing evaluation board can not only make some software can be debugged and modified in a well-proven environment but also make hardware development can refer to the standardized circuit design largely. At the same time, it can be used as a reference design of main circuit, which can shorten the development time of product in general, Gateway hardware block diagram is shown in Fig.3:

4. INFORMATION EXCHANGE PROCESS

The system information exchange process was shown in Fig.4, which was divided into the upload process of data and the download process of command, illustrated by the case of upload process [10]:

1) Sensor node of ZigBee network perform the

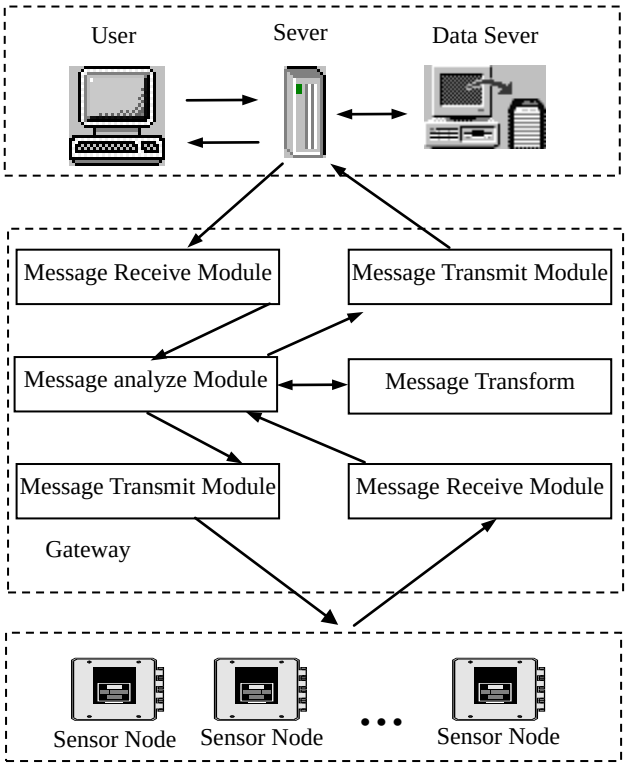

Fig.4 Message Transform Flow

operation of information acquisition, and then the results was sent to the message receiver module of extended services layer in gateway.

2) Message receiver module of extends services layer in gateway send the specific information depended on communication protocol of the device (ZigBee) to the message parsing module of the standard message form layer.

3) Specific information depended on communication protocol of the device (ZigBee) was transformed to standard message through that the message parsing module called the transform module.

4) The transmit module of extended services layer send the standard information to the server, then users can access the real-time information from the server.

Download process of control commands was similar to the data upload process, so it was unnecessary to go into details here.

5.CONCLUSIONS

The security management mode would go deepen continuously toward to integration, networkization, informatization and digitization, which was the inevitable development trends of airport security application, all airport security subsystem must have good compatibility and scalability, video monitoring, enclosure intrusion detection and alarm, access control, face recognition, intelligent analysis system will be further integrated. In order to adapt to the modern management mode, the traditional analog control system will must be instead of the digital network control system, which is an important issue that aviation airport security system would face in the future. in 2015, the number of airports will exceed 220, 63 new airports construction projects, 88 airport expansion projects, 20 airport relocation project in china, therefore, the proposed intrusion alarm system based on internet of things has reliable performance, flexible applicability and will has a broad application space.

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Author Introduction

Author1: (YAO XIAOFENG: associate profossor, received the M.E. Degrees from Dalian JiaoTong University. School of Electrical and Information Engineering, DaLian JiaoTong University, DaLian city, China. His current research interests include CAN fieldbus control system, and internet of things and so on.)

Author2: (CHEN XIAOLONG: He is a postgraduate student from Dalian JiaoTong University. His current research interests include CAN fieldbus control system, and internet of things)

Author3: (XU HUIPU: associate profossor, received the Ph.D. Degrees from DaLian Maritime University. Automation Research Center, DaLian Maritime University, DaLian city, China. Her current research interests include networked control system, sensor networks, time delay system.)